

Simulated Transmissivity of Mid-level, Mixed-Phase Clouds

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Abstract

Previous BACIMO conferences have indicated the need for Tactical Decision Aids (TDAs) that take weather into account. The increase in aircraft-to-ground engagement heights (currently near 15,000 ft) have increased the probability of target-obscuring clouds. Clouds that form in the mid-troposphere (near the current engagement heights) typically have temperatures below freezing. Studies have estimated ~30% of these clouds are mixed-phase, containing supercooled liquid water droplets as well as ice particles.

Results from previous Cloud Layer EXperiment (CLEX) field campaigns have shown that, in non-frontal, mid-level, mixed-phase clouds, the supercooled liquid droplets exist in a thin (100 – 300 m thick) layer at cloud top, with the largest ice water contents found below the liquid layer. This is contrary to the assumptions built into many operational forecast models that place the ice at cloud top where the lowest temperatures are observed. This work investigates the effect that this microphysical structure has on the ability of airborne infrared instruments to detect targets at the surface.

The MODTRAN radiative transfer program was used to simulate the view of a warm military target at the surface through a typical mid-level, mixed-phase cloud profile using a Forward Looking Infrared (FLIR) instrument (~11 μm). Simulations were performed at varying heights within and above cloud and at varying viewing angles. Results indicate that the supercooled liquid layer will significantly (if not completely)

obscure such targets from airborne FLIRs flying at or above the layer. The layer of ice particles only partially obscures the target. The obscuration is greatest at viewing angles further from nadir.